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CLEAN AND CLEAR

Keeping Soil on Construction Sites and Out of Streams

The Erosion and Sediment Control Practices Study
SUMMARY REPORT - JANUARY, 1993



A joint study by MTRCA and MOE with funding from the
Clean Sweep Lottery



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Erosion and Sediment Control

Muddy water, eroded and barren banks, aquatic habitats smothered by sediment. For too long, the destruction of rivers and streams has been considered an inevitable part of urban development.



Fig. 1 Careless construction - Humber River



Fig. 2 Sediment plume entering Humber River

At this bridge construction site on the Humber River in the Greater Toronto Area (GTA), the builders have made only feeble attempts to control the bank erosion and sedimentation caused by their work. (Fig. 1) Protecting the stream is clearly a low item on the contractor's priority list. Workers have erected silt control fences, but have installed them incorrectly, and regular maintenance is non-existent. Heavy loads of dirt are bursting out from under the fabric of the fence and entering the water. (Fig. 2) The plumes of sediment in this photograph represent literally thousands of tons of silt dumped into the Humber over the six months it took to build the bridge.

If this site were an isolated case, it wouldn't matter so much. After all, erosion is a natural process during which, over eons, hills flatten, shorelines build up, and rivers meander. But this example of erosion is anything but natural. And unfortunately, it is just one of many careless construction sites in the Humber River watershed, and one of thousands across Ontario. According to a field monitoring survey conducted by a joint study team from the Metropolitan Toronto and Region Conservation Authority (MTRCA) and the Ontario Ministry of the Environment (MOE), more than 80 percent of a random sampling of construction sites in Metro failed to provide adequate erosion and sediment controls.

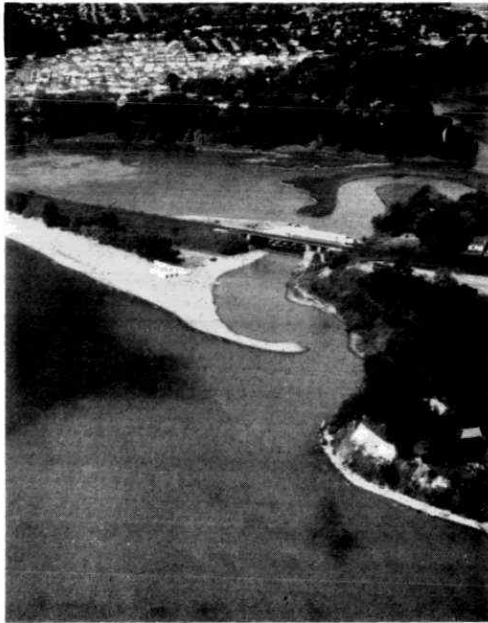


Fig. 3 Sediment plume at mouth of Rouge River

The cumulative effect of such massive erosion on Toronto's rivers and streams is staggering. It can be seen most dramatically at the mouth of the Don River. Each spring, engineers must dredge up and remove the accumulated sediment at the Don's mouth, the Keating Channel, for it hinders navigation and worsens flooding. The amount dredged up and removed is directly proportional to the amount of new development, highway and road construction, and instream works that took place in the watershed during the previous year. In 1988, a boom building year, more than 120,000 cubic meters of silt were dredged up from the mouth of the Don, at a cost of about \$1 million.

With that much sediment muddying rivers and streams, it's no wonder fish habitats are in danger. Suspended solids clog fish gills, smother shallow areas where fish lay eggs, and make life precarious for other animal life and aquatic plants. Nor are sediments, or suspended solids, simply floating dirt. There's mounting evidence that bacteria, toxic chemicals, and metals cling to sediment particles, and thus are more easily ingested by aquatic life.

A brown, turbid stream is not aesthetically pleasing to people either. And the condition of local natural areas affects people's attitudes towards their neighbourhood and community. A recent survey by the Metropolitan Toronto and Region Remedial Action Plan (RAP) indicated that to the public, clear water means clean water, and cloudy means dirty. Clarity ranked second only to toxic contamination as the public's major concern about water quality.

Recommendations

In October 1991, a study group composed of representatives from MTRCA and MOE determined to find the real causes for poor erosion control at construction sites, and to make recommendations that would protect nearby watercourses effectively. The work was funded by the Clean Sweep Lottery and the Toronto Area Watershed Management Extension Studies, while the Provincial Urban Drainage Advisory Committee (PUDAC), which had identified sediment and erosion control as a key element in its 1991/92 action plan, acted as the steering committee. From the outset, the study focused on erosion at urban construction sites in order to fill a significant gap in understanding. Other initiatives were already well underway to address rural erosion problems, such as Clean Up Rural Beaches (CURB), and erosion due to highway construction. Together, these efforts represent a comprehensive approach to a watershed's erosion and sedimentation problems.

To solve the problem of erosion and sedimentation at urban construction sites across the province, the study group recommends:

1) That local municipalities adopt and enforce Top Soil Preservation By-laws, allowing them to control erosion and sedimentation at construction sites from an early stage;

and that the Province aid the municipalities by developing a Model Top Soil By-law;

2) That the Province set up and carry out compliance monitoring programs on an interim basis in areas that do not have a Top Soil By-law, and audit construction sites in municipalities that do;

3) That the Province reallocate and reorganize staff and funds at the Ministry of Natural Resources (MNR) and MOE to better enforce and prosecute under the Federal Fisheries Act and the Ontario Water Resources Act (OWRA), in order to strengthen new local Top Soil By-laws;

4) That the Province encourage the development of a training course for contractors, consulting engineers, developers, and employees of regulatory agencies in the proper practices of erosion and sediment control at construction sites;

5) That the Province sponsor smaller, hands-on workshops for those same groups, emphasizing field work, and encouraging discussion and feedback.

The Provincial Urban Drainage Advisory Committee (PUDAC) may be an appropriate group to conduct such workshops, augment the existing Guidelines, and produce a reference handbook for contractors in the field.

This summary report explains the background and rationale for the above recommendations.

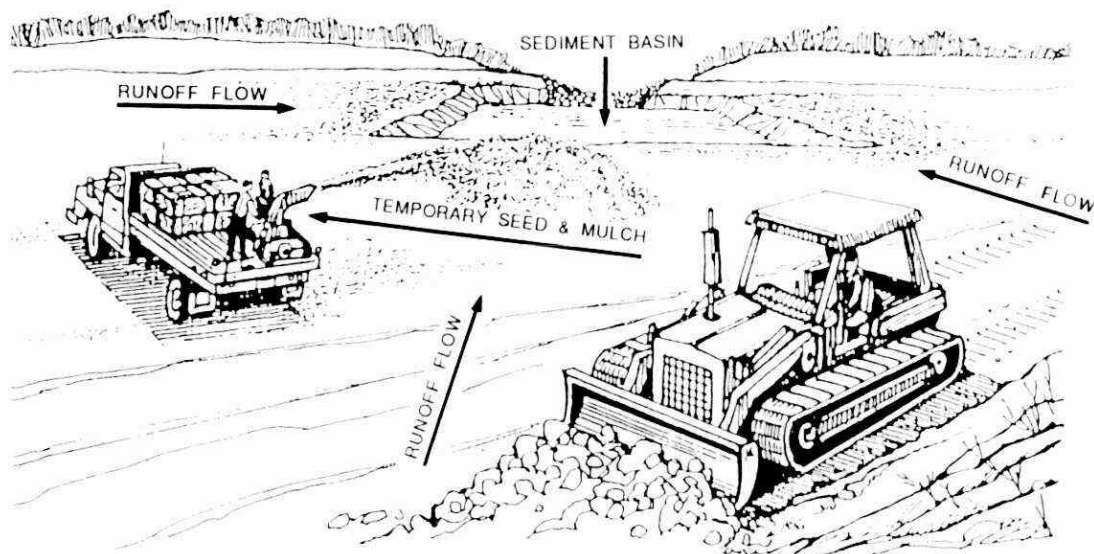


Fig. 4 Combining control measures - mulch/sediment basin

What's the Real Cause?



Fig. 4a Sediment basin

Uncontrolled erosion from urban construction sites is not a technical problem. The technologies to halt the silting up of rivers and streams already exist and have existed for some time. In fact, the good news is how effective, how simple to install and maintain, and how reasonable in price most measures for erosion and sediment control actually are.

It's important to grade and stabilize large sites in stages. Preserving the existing vegetation or planting new temporary cover after grading reduces runoff and erosion. (Fig. 4.) Combining control measures, such as temporary mulch and seed and a sediment pond, can be effective during the planning and field operation phases of construction.

Erosion control matting, an option the Humber River bridge contractor might well have considered in addition to his silt fence, provides temporary stabilization of even quite steep banks and ditches during construction, until underlying grass seed has taken root. Another option for steep banks is creating a rough surface to keep the seeds in place, simply by driving a bulldozer up and down the slope. (Fig. 5.)

A series of rock check dams can reduce the flow of sediment in ditches and swales, as they are much more durable than the straw bales that are often used. (Fig. 6) A better use of straw bales is in combination with fabric silt control fences to halt the sheet erosion that can happen when rain hits a flat, graded area. And several different types of small, temporary sediment traps and basins act as intercepting ponds during storms, allowing silt to settle before the runoff flows off the site or into a storm sewer system and eventually into the stream.

These are only a few of the options described and illustrated in many provincial documents, such as the 1987 Guidelines on Erosion and Sediment Control for Urban Construction Sites. This and similar manuals are well known to the building industry.

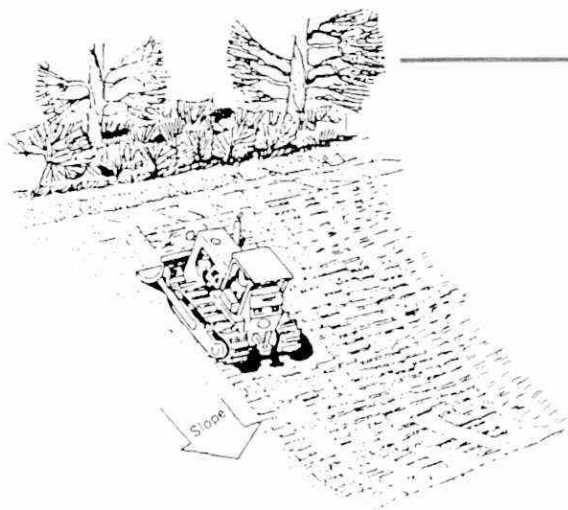


Fig. 5 Roughening surface

So construction-site erosion is more complex than a technical problem. It's a problem of attitudes and priorities among developers, consulting engineers and contractors, of overlapping jurisdictions among government agencies, of too few site inspectors, of ill-understood and under-used environmental legislation, of no clear sense of who is ultimately responsible for the health of a watercourse.

Consider all the people involved in a typical development project. There's the developer who owns the land, the consulting engineer hired to design the project, and the contractor who carries out the work. There's the local municipality that checks to make sure standards for lot grading, building structures, and servicing are maintained, and several provincial government agencies-- (MNR), (MOE), and the local Conservation Authority (CA)-- that check the consultant's plans for environmental concerns, including erosion and sediment control.

But all too often, the following scenario is what actually happens. On paper, the development plan looks good. The municipality approves it for lot grading, building code, and servicing requirements, and the appropriate agencies approve it for environmental protection. But when the work begins, the erosion control measures that looked fine on paper are not always carried out. Perhaps they aren't installed at all, or are installed improperly or half-heartedly, or are put up as a matter of form and then ignored while construction (and erosion and siltation) proceeds. If the work stops, due to a strike, harsh winter conditions, or an economic slowdown, the site is abandoned, and any erosion control measures are left to the elements.

In addition, it is rare to find anyone on the development team who is ultimately responsible for environmental protection. Often the consulting engineer fails to instruct the contractor in how to install and maintain the erosion controls properly, or fails to keep a close eye on the site during the months of construction. Most often, the contractor does not maintain erosion control measures on his own initiative, but only when confronted by the consulting engineer or a regulatory agency. And even a contractor

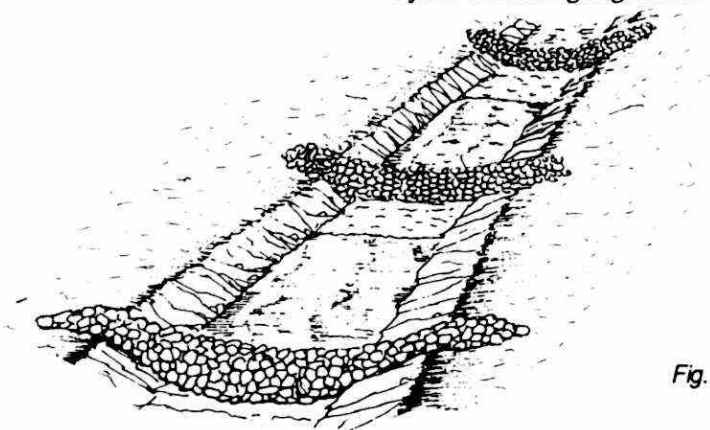


Fig. 6 Rock check dams

who does desire and sincerely try to protect a nearby stream may not have the experience and expertise to install, maintain, and monitor control measures appropriate for different parts of his site, or implement an emergency plan for specific problem areas.

There are exceptions, of course. Some developers have been attentive to erosion and sediment controls for many years. However, the unpalatable truth is that the majority of developers, consultants, and contractors only give lip service to the idea of protecting the local environment. In reality, out in the field, most treat erosion and sediment controls as a nuisance, for they seem to contribute little to finishing the project and earning the dollars. A revealing response of this study's survey of attitudes in the construction industry is that 79 percent of the developers, consultants, and contractors surveyed felt that they were well equipped to design, construct, maintain, and monitor erosion and sediment control. Yet 80 percent of construction sites proved to be deficient in those very measures.

Government is Guilty Too



Fig. 7 Grading on construction site

The private development industry is not solely to blame for the continuing siltation and degradation of Ontario's rivers and streams. Municipalities undertake construction projects that pollute and clog up streams too. So do the Ministry of Transportation and even Conservation Authorities. So, on a smaller scale, do individual landowners and home owners.

In a larger sense, governmental authorities can be said to collaborate in despoiling watercourses. For who is regularly inspecting urban construction sites, working with contractors to improve erosion control measures, enforcing environmental laws and regulations, and, when need be, bringing legal action against offenders? Unfortunately, no one is—at least not in a rational and effective manner. The passive role of government has undoubtedly contributed to the low priority the development industry gives to erosion and sediment control.

The legal authority of municipalities in regard to construction sites is generally confined to enforcing the Drainage Act and the Ontario Building Code. Their focus is on lot grading, building construction, and servicing for the development. Most municipalities in the Toronto area do not even review erosion and sediment control plans when they approve blueprints for subdivisions.

Nor are the provincial agencies much more effective. The Ministry of Natural Resources, the Ministry of the Environment, and local Conservation Authorities all have somewhat different interests regarding erosion at construction sites, which makes for overlaps in jurisdiction, delays in approvals, and bureaucratic tangles. In fact, field observations in the present study underscore the fact that no government agency has a comprehensive, proactive erosion and sediment control monitoring program for urban construction sites. MNR tends to get involved only when fish habitats are threatened and the Federal Fisheries Act can be invoked. Conservation Authorities tend to be more involved on site, but their mandates cover floodplain land only, not the tablelands where construction takes place. And the MOE is not applying their Enforcement and Investigation Branch to police sediment control.

Even when these agencies review development plans in the pre-construction phase, the reviews are not always comprehensive. Their response tends to be either a blanket acceptance or rejection of plans, most frequently the former. The problem may lie in the lack of a consistent approach among the various agencies, or in the need for greater expertise in those who review development plans. When government employees in MOE, MNR, and local CAs were asked, in this study's survey, whether they felt equipped to handle erosion and sediment control during development, 62 percent said no. The most common reason given for this inability (36 percent) was too few staff to act as reviewers and inspectors.

The laws and regulations surrounding construction site erosion are no less confused. Several different Acts can be applied to erosion and sedimentation at construction sites, depending upon the circumstances: the Ontario Water Resources Act, Environmental Protection Act, Top Soil Preservation Act, Federal Fisheries Act, and the Conservation Authorities Act. These Acts are administered by different Ministries and carry widely varying penalties. What is lacking is a concerted approach by the Province and local municipalities, as well as revisions to update the legislation, so that careless owners of construction sites can be made accountable for damaging field operations.

The Erosion and Sediment Control Practices Study

During the past several years, the Remedial Action Plans (RAP) and the Royal Commission on the Future of the Toronto Waterfront have emphasized the need to reduce the damage of stormwater runoff in Toronto's rivers, streams, and its waterfront at Lake Ontario. Sediment loads from urban construction sites are a major component of urban runoff. That is why the Metro Toronto and Region RAP specifically targeted erosion from construction sites in its Draft Options Discussion Paper. Virtually every group that has studied the Toronto environment and other urban areas from an ecosystem perspective agrees that poor construction practices cause serious damage. But so far no one has achieved any solutions.

The MTRCA/MOE study team spent eight months gathering a great deal of information and experience, through five different methods. A field monitoring program checked the effectiveness of erosion control methods at many construction sites. A survey of consultants, contractors, and developers on the one hand, and officials at municipalities, Conservation Authorities, and provincial agencies on the other, gauged attitudes towards the problem of construction site erosion and its solutions. A one-day educational seminar for those same groups served as a pilot for possible regular seminars, and an opportunity to gain additional input from participants. An analysis of current legislation and policies relevant to erosion and sedimentation at construction sites clarified a confusing situation and allowed the study group to make a firm recommendation as to which law to emphasize. Finally, four demonstration projects took the educational approach of the seminar to the field, achieving effective erosion control through cooperation among government officials, developers, consulting engineers, and contractors.

Field Monitoring



Fig. 8 Servicing to begin on subdivision - Don River

Between October 1991 and June 1992, MTRCA staff monitored erosion control measures at 21 construction sites in the Humber, Don, and Rouge watersheds. The sites represented several activities, such as bank stabilizations, bridge construction, and subdivisions. All plans had received prior approval from regulatory agencies. The monitoring, discussions with contractors and consultants, as well as the survey results described below, allowed staff to rank control measures as to their effectiveness.

The overall results of the field study were dramatic and disappointing. Most sites were polluting nearby watercourses with sediment.

The field monitors concluded that using only one erosion control technique at a site will not work well. There must be a comprehensive erosion and sediment control plan, including so called "stage phasing"--ways of stabilizing areas of a site when they are not being actively worked on, in order to minimize the exposure of the soil to erosion. At least two sediment control measures must be used in combination, to provide backup if one

fails. Furthermore, there must be a detailed maintenance schedule of the control measures by the contractor, a compliance monitoring program administered by government, and consultants must give more thought to erosion control when designing a project.

The field survey was not limited to documenting problems. The staff also notified consultants, contractors, or municipalities of the problems at the sites, gave 80 hours of on-site training and guidance, and followed up to ensure that proper corrections had been made. Discussions with developers, contractors, and consultants on site also gave the study team insight into those individuals' knowledge levels and attitudes about erosion control.

Survey

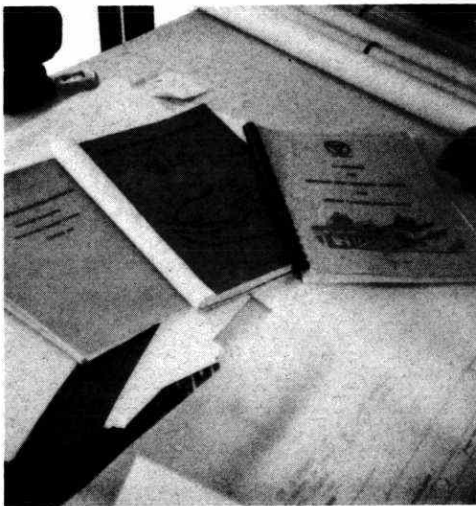


Fig. 9 Enough Guidelines

In cooperation with the Provincial Urban Drainage Advisory Committee (PUDAC), in February 1992 the study group sent questionnaires to 325 people in the construction industry and relevant government offices throughout Ontario. The main purpose of the survey was to assess the usefulness of the 1987 Guidelines on Erosion and Sediment Control for Urban Construction Sites and the effectiveness of specific control measures.

Two groups of people were surveyed. Group 1, 54 percent of the sample, represented the development industry, and was composed of contractors, consulting engineers, and developers. Group 2, with 46 percent of the sample, were employees of municipalities, provincial agencies, and Conservation Authorities. Ninety-three percent of both groups responded positively when asked if erosion and sediment control during construction was important, citing water quality and protection of fisheries (50 percent) and maintenance and servicing problems during and after construction (25 percent) as reasons.

As for the 1987 Guidelines, while 70 percent of those surveyed said they used the Guidelines and considered them technically adequate, most also felt they could be improved to include more details on how to maintain erosion controls, and how to design a comprehensive erosion control plan. The study reviewed various other guidelines used across North America, and found the 1987 Erosion and Sediment Control Handbook published by the Delaware State Department of Transportation to be a more useful document.

It is revealing that only 19 percent of those in Group 1, the development industry, completed and returned their questionnaires, compared with 41 percent in Group 2, the government officials. Response rates varied from 86 percent at Conservation Authorities to only 5 percent among developers. And of course the most telling finding of the survey was that 79 percent of Group 1 respondents said yes, they were equipped to handle erosion and sediment control during development, whereas the field monitoring study showed 80 percent of the construction sites had ineffective erosion controls.

Educational Seminar

In the above survey, the development industry had identified education and training as the number one priority for improving erosion control. On April 14, 1992 the study group, again in cooperation with PUDAC, held an all-day seminar attended by 235 participants from the construction and development industry as well as from municipal and provincial government. The seminar emphasized the importance of a team approach to good construction practices. While most of the lectures and displays were on technical topics, David Crombie, Commissioner of the Royal Commission on the Future of the Toronto Waterfront, put the technical discussions in the larger context of an ecosystem approach.

In written evaluations at the end of the day, 80 percent of participants said the seminar had helped them understand the issues better, and 88 percent wanted additional informal, hands-on workshops.

Legislative Review and Evaluation

A solicitor completed a review of all legislation relevant to construction practices in an urban setting in Ontario. Given a typical scenario--after a permit is granted for a development project, poor erosion control practices allow soil to enter a nearby watercourse--the solicitor investigated how much power six different acts would have to prosecute the offence.

The Ontario Water Resources Act (OWRA, R.S.O., 1990) was found to be useful for prosecutions only when a water quality violation affected human health, such as near a drinking water supply or a swimming area.

The Environmental Protection Act (EPA, R.S.O., 1990) applies mainly to spills--discharges from containments--that seriously impair the immediate environment, usually affecting fish habitats or human health.

The Federal Fisheries Act (R.S.C., 1985) carries a great deal of clout, since a first offence can earn a fine of up to \$1 million, but in most cases the Act is invoked only after the damage is done.

The Conservation Authorities Act (R.S.O., 1990) grants local Authorities regulatory power only on a watershed's floodplain (where no building is usually permitted), grants them only limited jurisdiction over water quality issues, and allows fines of only \$1000.

The Top Soil Preservation Act (R.S.O., 1990), administered by the Ontario Ministry of Agriculture and Food and originally intended for rural land, may seem a peculiar first choice for legislation to protect urban streams. Yet the Act, adopted by municipalities as a by-law, has several advantages: it allows for earlier intervention in the development process, before damage to the environment has occurred; it gives municipalities significant control at the design stage of development; at \$5000, its fines are adequate; it provides for a letter of credit from the developer for several thousands of dollars, on which the municipality can draw for remedial work if necessary;

and using the By-law could eliminate the bureaucratic overlaps between MNR and CAs in the approval process for erosion controls.

In the future the proposed Ontario Environmental Bill of Rights (EBR) could give the public unprecedented powers to protect the environment. Private citizens would have a say in the development process, could propose new legislation or amendments to existing legislation, and could force government to be more active in the investigation and prosecution of polluters.

Demonstration Projects

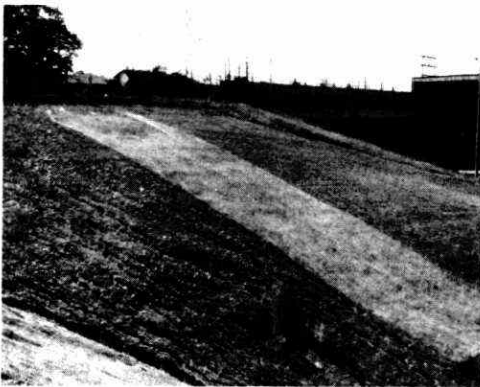


Fig. 10 Slope stabilization with erosion control matting

The study group chose four construction sites where obvious damage was being done to the environment by erosion and sedimentation, and worked closely with on-site consultants, contractors, and developers to remediate the damage with more effective methods. One project was a steep slope stabilization with matting, another a retrofit of an existing stormwater management pond to turn it into a sediment basin during a long period of inactivity in construction. (Fig. 10 and 11.) A third project was a stabilization of a stream crossing after a bridge contractor had defaulted and left the site, and the fourth was the installation of a silt trap to prevent sediment from pouring down a storm sewer catchbasin in a newly completed subdivision.

These demonstrations served as teaching projects. Though all were necessary emergency measures for rapidly deteriorating sites, they also served as models for the small-group, hands-on practical work that participants at the one-day seminar had requested.



Fig. 11 Retrofit storm water management pond

The Solutions



Fig. 12 Temporary seeding during construction shut down - Before



Fig. 13 After

Considering all five aspects of the study together, the MTRCA/MOE study group concluded that erosion and sedimentation at urban construction sites is not a technical problem, but a problem of people and of process. Certainly some changes would be helpful to the 1987 Technical Guidelines, but that is not the heart of the study's recommendations.

A concerted, double-barrelled attack is needed to solve the widespread problem of erosion at construction sites. One part of the solution will be more aggressive enforcement of environmental legislation by government. The other part will be an emphasis on training and education, a more cooperative effort between government and the construction industry.

Enforcing legislation effectively will mean some administrative changes. This study group believes that municipalities should have more jurisdiction over developers' and builders' plans for erosion and sediment control. Municipalities should review erosion control plans at the same time that they review plans for grading, building and servicing requirements.

The most useful mechanism for extending the authority of municipalities into this aspect of environmental protection is the provincial Top Soil Preservation Act, which a municipality can adopt as a by-law. Such a by-law allows the local government to intervene early in the development process, before any damage is done to watercourses, indeed well before the ground has been broken. That is preferable to the current situation of MNR and Conservation Authorities reviewing applications for development early on, but having limited authority to enforce compliance in the field.

Already, a few municipalities in the Greater Toronto Area have adopted their own Top Soil By-laws. The City of Mississauga is a good example. There, a local By-law has been in effect since October 1991, and in its first year, 86 applications were processed. Developers must submit blueprints showing fail-safe erosion control plans. The \$500 plus \$25 per hectare application processing fee helps offset the cost of an inspector who monitors specifically for erosion control. Mississauga officials take a

cooperative attitude with developers, providing a check list of items to be included on plans, and holding conferences with developers if misunderstandings arise over the By-law's requirements.

Yet although no prosecutions have been necessary to date, if a developer were to disregard the local By-law, not only would he have to stop work, but if the project was adjacent to a watercourse, he would be subject to prosecution under the Federal Fisheries Act, with its substantial penalties.

Indeed, encouraging local municipalities to adopt Top Soil By-laws is not a way for provincial agencies to abdicate responsibility and to turn all the work of assessment, monitoring, and prosecution over to municipalities. The study group sees clear roles for provincial agencies. The Province should take the lead in directing the resources of MNR and MOE more effectively to compliance monitoring and enforcement. Polluters should be prosecuted to the full extent of the law, and made high-profile examples to deter others from careless construction practices. If erosion and sedimentation in urban construction does not become a much higher priority with regulatory agencies, it surely will remain a low one among developers, consulting engineers, and contractors.

At the same time, government should take a positive, cooperative approach with members of the construction industry, to ensure that they are well trained in proper erosion control practices. The study group believes that the most effective insurance would be a provincially designed and run course, with certification or licensing earned upon completion. In addition, informal workshops would give contractors, developers and consultants more hands-on experience in the field, and could respond better to their immediate concerns and problems. Recall that in the study survey, the developers, consultants, and contractors indicated that the most effective way to improve erosion and sediment control practices would be to concentrate on education and training.

Moving Into Action



Fig. 14 Education

To improve urban construction practices and minimize their impacts on the environment, this study's recommendations focus far more on human processes than on engineering solutions. Such goals are almost always more difficult to achieve than technical fixes. They require education and change, resetting agency priorities and manpower allocations, rethinking and enforcing legislation, and coordination and cooperation between industry and government, as well as among government agencies. In other words, they require partnerships between different interest groups to achieve progress, rather than a single body dictating what is to be done.

Implementing the study's recommendations will go a long way towards ending poor construction practices in Ontario. In the long run, that can only improve public perception of the local environment, boost community esteem, and significantly improve the health of local natural environments and the larger ecosystem of which we are all a part.



Fig. 15 Recreation



Fig. 16 Fishing

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